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Sediment Transport Mechanisms and Tectonic Origin of Quaternary Sediments in Saghalak-Sar Wetland, Rasht, Iran

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ABSTRACT

The importance of wetlands as unique environments and rich in various elements from an environmental point of view is increasing every day. In this research, the grain size and geochemistry of Quaternary sediments in Saghalak-Sar lagoon, as one of the wetlands in Guilan province, north of Iran, were investigated. For these propose, 74 surface and subsurface samples of the above sediments were collected and analyzed for grain size and finally, frequency of major elements and sub-elements oxides was determined by ICP and XRF, respectively. The granulometery results showed that the sediments can be classified into eight sedimentary classes including slightly gravelly muddy sand, slightly gravelly sandy mud, sandy mud, gravelly muddy sand, gravelly mud, Slightly Gravelly Sandy Mud, and gravelly sand. Surface adsorption of sediment samples are moderate - weak and the tilting in most samples is negative towards negative coarse grains. The frequency of sediment populations in the region is not same so, the mutation population is the most frequent in the majority of the samples. Based on the results of texture analyses, these sediments are probably transmitted to the basins by the river or muddy streams. Also, based on the compatibility of wetland samples on the two-axial diagrams of the main elements oxides, *i.e.,* Fe_2O_3 + MgO versus Al_2O_3/ SiO_2 and TiO_2 and log (K_2O / Na_2O) versus SiO_2, as well as the triangular diagrams of the sub-elements Zr, Th, La, and Sc, it seems that the above sediments are more belong to the range of oceanic arc islands and continental arcs, and are composed of subduction rocks.

Keywords: Wetland, Sediment, Saghalak-Sar, Tectoinic

INTRODUCTION

Wetlands, as unique, rich and fertile ecosystems, are among the most vital environments in the world. These ecosystems have many benefits and values, including water supply, storage of food from floodplains, wood production, storing river sediments, water storage, flood control, etc. (Kazanci *et al.,* 2017; Bruland *et al.,* 2004). Quaternary sediments of wetlands are the main components of our environment and an important source of clastic, organic and chemical substances that can be caused by natural processes and erosion or created by human intervention.

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Sediments are a reservoir of pollutants in aqueous media and therefore are emphasized in most studies for better use and the determination of the burden of contamination of aquatic environments (Salomons and Forstner, 1984; Sobczyński and Siepak, 2001; Eggleton, 2004; Ying Wang, 2011). In addition, wetlands play an important role in trapping river sediments and nutrients and reducing their transmission to seas (Bruland *et al.,* 2006). These sedimentary environments have an effective role in preventing the occurrence of floods and act as a kind of sedimentary trap (Kazanci *et al.,* 2004). The composition of siliciclastic sediments such as sand and mud in relation to tectonic position, origin and proximity has been studied by many researchers (Armstrong-Altrin and Verma, 2005; Osae *et al.,* 2006; Jafarzadeh and Hosseini-Barzi, 2008; Al-Juboury *et al.,* 2009; Adabi, 2011; Etemad Saeed and Hoseini Barzi, 2009; Bite Gol and Hosseini Barzi, 2011). Generally, the composition of these sediments is affected by transport factors, aerodynamic rates, features of origin rocks, low and high, climate, tectonic activities and diagenetic effects (Whitmore *et al.,* 2004; Von Eynatten, 2004; McBride, 1994). Therefore, geochemical studies of sediments are a good complement to petrology and sedimentology studies. The Caspian marginal lagoons are formed under three main processes of longitudinal coastal sediment transport, the increase of Caspian Sea level, and or anticline-syncline structures (Leontiev *et al.,* 1977), and the considered wetland is formed by the third process. According to Leontiev *et al.* (1977), the sediments of the Iranian coastal shores from the borders of Azerbaijan to Turkmenistan originate from the Alborz slopes. Therefore, studies of surface sediments and investigating their status in terms of sediment type and distribution of these wetlands can be a suitable basis for subsequent studies.

Saghalak-Sar lagoon is one of the Caspian marginal wetlands that are probably resulted from the anticline-syncline process (Nogol *et al.,* 2004) with regard to its relatively large distance from the sea and the tectonics of the region. The source of the Quaternary sediments of this wetland is Alborz. Therefore, with regard to the increasing trend of drought, the decrease of surface water and groundwater in country and the need for water resources management and since this wetland is located near Rasht, its maintenance and solving its environmental problems (sediment volume control, the potential for accumulation of human and natural contaminations in sediments, etc.) are particularly important. Furthermore, it is a tourist destination due to the high tourist attractions and its maintenance will be of special significance. The purpose of this study was to present a picture of the sedimentary and geochemical characteristics of the Quaternary sediments of the wetland bed and the factors affecting their formation (Jafarzadeh *et al.,* 2014; Cullers, 2000). It also tried to use the results of the geochemical analysis to obtain information about the source rock and the tectonic site of the sediments and the accumulation of different elements in the sediments of the wetland, as well as the weathering conditions of the above area.

METHODOLOGY

To begin the study, the area of the wetland was determined using aerial photos and satellite imagery and Arc GIS software then 70 samples of the sediments in the form of 13 cores and 12 surface sample of the wetland were taken using the Auger and Van Veen Grap device considering (Fig. 1). In each core, the samples were selected according to the apparent variation in grain size, color, and sediment composition and were collected in separate containers. The samples were graded in the laboratory according to dry sieving and using a shaker and Anderson method (Anderson, 2004). Then, the statistical and sedimentation parameters of the particles (sorting-tilting, stretching) were calculated. In addition, the frequency percentage diagram of Folk (1957) was plotted using the Gradistate software (Blott and Pye, 2001). The suspension population and the mutation and deflection of sediments and their turning point were calculated by using the accumulation diagram (Visher, 1969). Then, using the above data, based on the Folk (1954), the sediment type was determined and the facade columns were plotted in 13 cores based on the depth and by Rockworks software. 66 samples of fine sediments (less than 62 microns) were analyzed by X-ray fluorescence (XRF) to determine the frequency percentage of 13 oxides of sub-elements. Moreover, 12 samples of fine-grained sediments were analyzed by the spectrophotometer radiation (ICP-OES, MS) and the frequency of 54 elements was detected. Finally, the interpretation of the sedimentary environment and the tectonic origin based on the geochemical data and the Bhatia (Bhatia, 1983) and Rosser and Korsch diagrams (Roser and Korsch, 1988, 1986) was carried out.

STUDY AREA

Saghalak-Sar Lake is 15 km off the south of Rasht, in the village of Lakan in Gilan province, in the geographical location of 37°,09´,23˝N and 49°,31´,30˝E (Fig. 1). The water of this lake is supplied by atmospheric precipitation and upstream springs in the region, the lake height is 64 m above the sea level, the length of the lake is about 600 m and its width is 500 m, and its area is 15 hectares. According to (Karimkhani, 2016) the studied area is a part of the drought zone of Sefid Roud Delta and is influenced by its sedimentation processes.

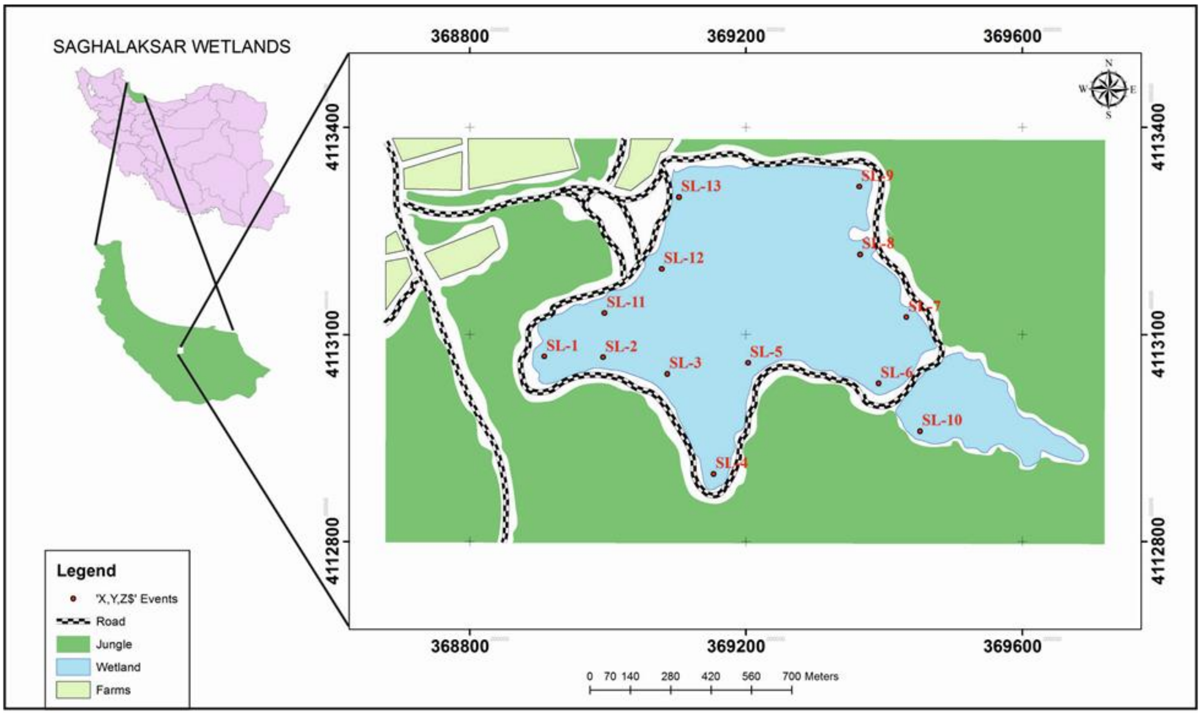

Fig1: Geographical location of wetland and location of sample points.

DISCUSSION

The study of clastic sediments deposited in the wetland is very effective in terms of sedimentological properties (facies, texture, color, and mineral type) and their chemical elements for assessing the geological status of the region, including determining the origin of sediments, the ancient tectonics, the processes during transmission, sedimentation and changes after sedimentation, as well as weathering and erosion around it**,** and identification of these processes can solve many environmental changes (Das *et al.,* 2006). Accordingly, this study was carried out in relation to sedimentology studies resulting from granulation and geoscientific studies with the aim of assessing the geological status of the region.

Sedimentary facies and sedimentation factor in subsurface sediments:

The analysis of the distribution of sedimentary grains is of particular importance for the comparison of different samples with each other, because it is possible to determine the various properties of the sediments and processes that have caused them to form (Mycielska-Dowgiałło, 2011; Flemming 2007; Hartmann and Flemming, 2007; Szmańda, 2007; Weltje and Prins, 2007). Therefore, after grading the sediments and determining the weight percent of each category of particles size, the dispersion charts of the particles size are drawn and according to these graphs, statistical parameters are obtained.

Since the prevalence of coarse grains in sediments, even to a slight level, is valuable for interpreting the environmental energy and the type of environment (Mousavi Harami, 2004), these sediments were named in the Folk triangular diagram despite the low amount of gravel. As you can see, these specimens are classified in 8 types of sediments (slightly gravelly muddy sand, slightly gravelly sandy mud, sandy mud, muddy sand, gravelly muddy sand, gravelly mud, Slightly Gravelly Sandy, and gravelly sand). Nearly in the majority of the sediments, the sand is the main component of the sediment name and forms the most abundant grain (Fig. 2). Two types of sediment are observed more at a depth of about 20-40 cm. (Fig. 3).

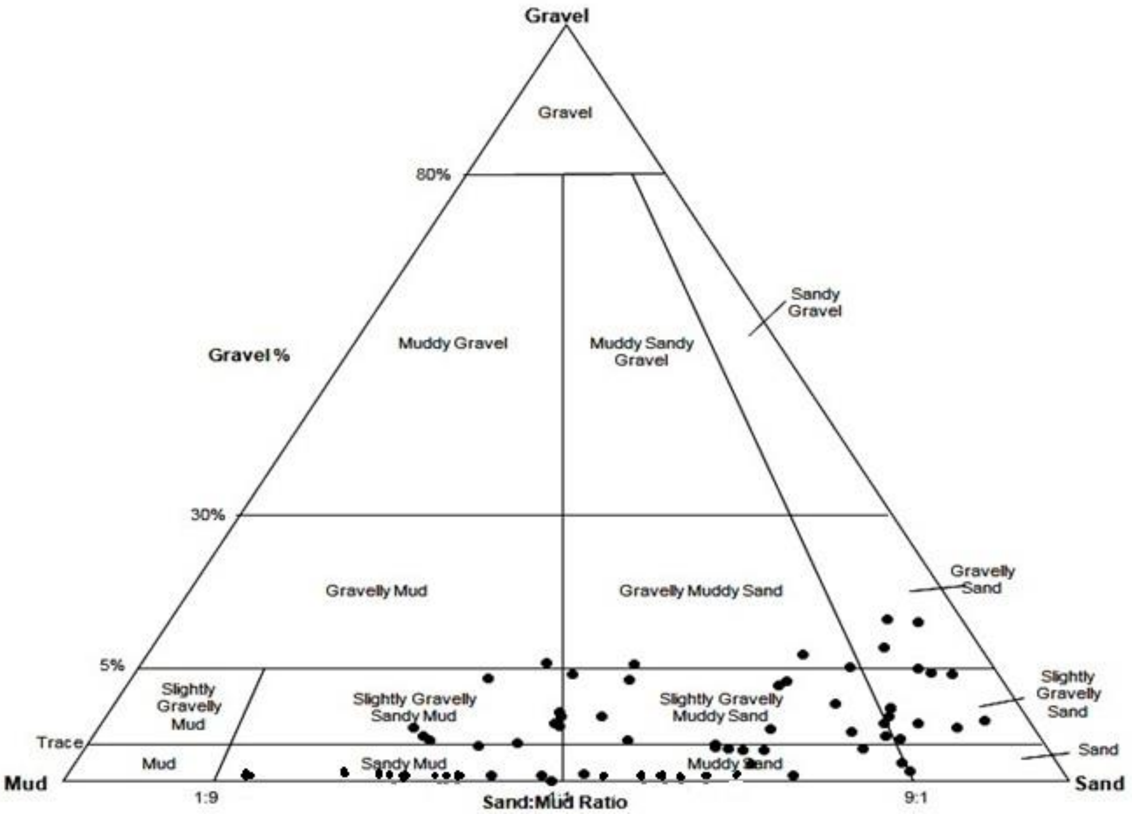

Fig. 2: Sediments type in the studied area.

In cores 1 to 8 in the west and south of the wetland, the percentage of sand in most samples is less than that of the mud, which indicates the lower energy of the carrier (Fig 3b, Fig 3c). In cores 8 to13 in the north and east of the lagoon at the entrance of the waterways, the amount of sand is higher (Fig3b, Fig3c), and in cores 12 and 13, the entry of one of the branches of Sefid Roud delta, gravel is more abundant than the other ones (Fig. 3a).

The bell-shaped curve of particle is leptokurtic in a number of samples (in the core 4, 8,3,6,2) and show that sand grains is well sorted but the rest of the samples have a mesokurtic to platykurtic curve that indicating sands is poorly sorted maturing resulting from sedimentation in muddy or river flows (Ramanathan *et al.,* 2009). Also coarse Skewed (less than zero) is showing environment had high energy (Feiznia, 2008; Mousavi Harami, 2004).

According to the classification of standard deviations and sorption (Folk and Ward, 1957; Friedman, 1961), sediment sorting in most samples is moderate to bad. This moderate to bad sorption is observed in river sediments and mudflows (Opreanu *et al.,* 2007; Ganjoo and Kumar, 2012). However, at the depths of 80 to 100 and 100 to 120, the sorption is good in most of the cores, suggesting that the sedimentation factor in the lagoon has had greater energy at this time (Lewin and Brewer, 2002; Feiznia, 2008).

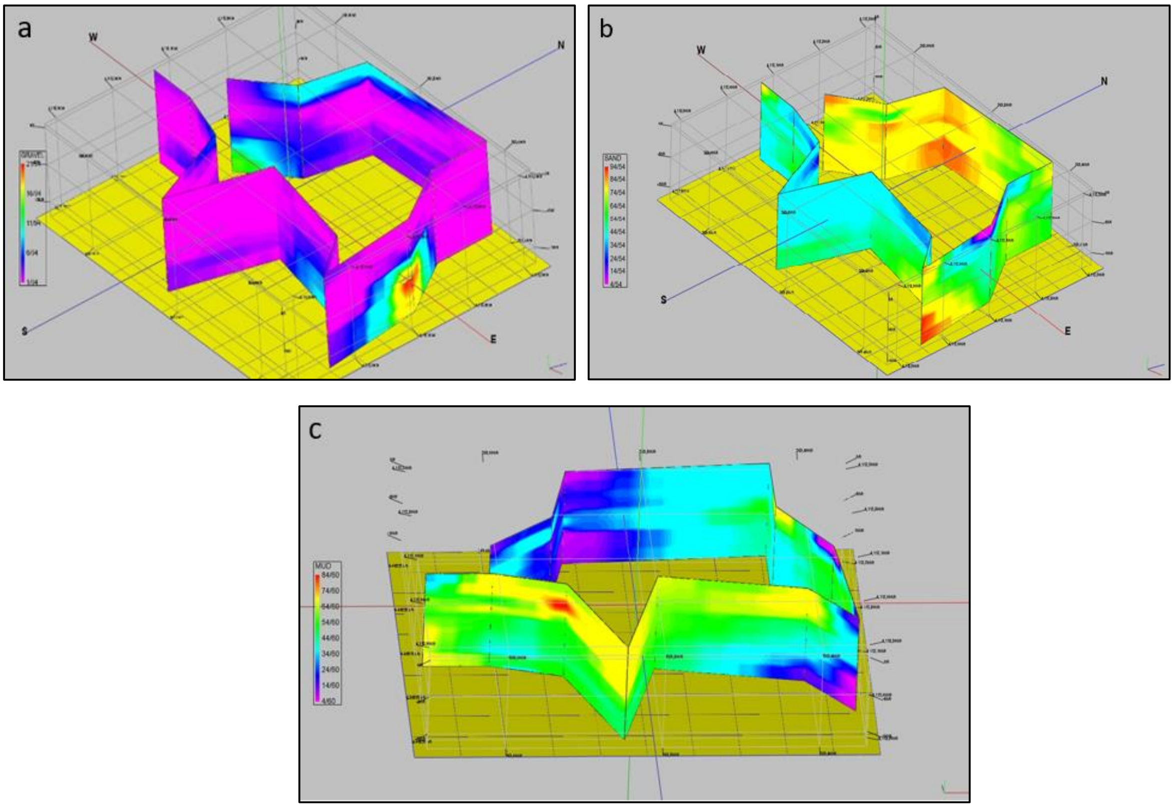

Fig. 3: Characteristics of sediment particles in surface sediments.

The number of sediment populations in the sediments of the region is 2 to 3, but most of the sediments have 3 populations, the frequency of the suspension varies between 5 and 70 percent, and the frequency of mutation population, which is the most frequent in most samples, is between 29 and 92 percent. Its false population is very low in most samples, and varies from 0 to 14 percent and can result from the river flow (Opreanu *et al.,* 2000). However, at the depth of about 20 to 40 cm in most of the cores, there are often sediments whose suspension population is very high and the mutation population is reduced that probably results from mudflows (Mycielska-Dowgiałło *et al.,* 2011; Feiznia, 1999) (Fig. 3).

Sedimentary facies and sedimentation factor in surface sediments:

The results of the granularity of surface samples in the wetland bed (Sw1 to Sw12) indicate that the sediments currently entering the wetland are mostly Gravelly Sand facies and have a high amount of sand and a small amount of mud and gravel. In some surface samples such as Sw11, the rate of gravel is more indicating higher carrying energy (Mousavi Harami., 2004) (Fig 4a).

The deposits have three communities. The rate of the suspension (mudd, clay) varies between 5% and 70%, and the rate of sand population is between 29% and 92% (Fig 4b, Fig 4c). Its gravel population is very low in most samples, and varies from 0 to 14 percent and can result from the river flow (Opreanu *et al.,* 2007) However, at a depth of about 20 to 40 cm, suspension population increase, and the sand population reduced that probably results from mudflows (Mycielska-Dowgiałło *et al.,* 2011; Feiznia, 1999) (Fig. 4).

Geochemical studies:

The main and secondary elements of the sedimentary deposits depend on factors such as the composition of the source rock, ups and downs of the region, and the weather (Dey *et* *al.,* 2009; Taylor and McLennan, 1985; Cullers, 1995; 2000). Therefore, the sedimentary basin can be detected by using graphs such as Batti, Rosser, Cyrus and Michelin and so on, which are presented by different scholars (Bhatia, 1983; Bhatia and Crook; 1986; McLennan *et al.,* 1993; Roser and Korsch,1988).

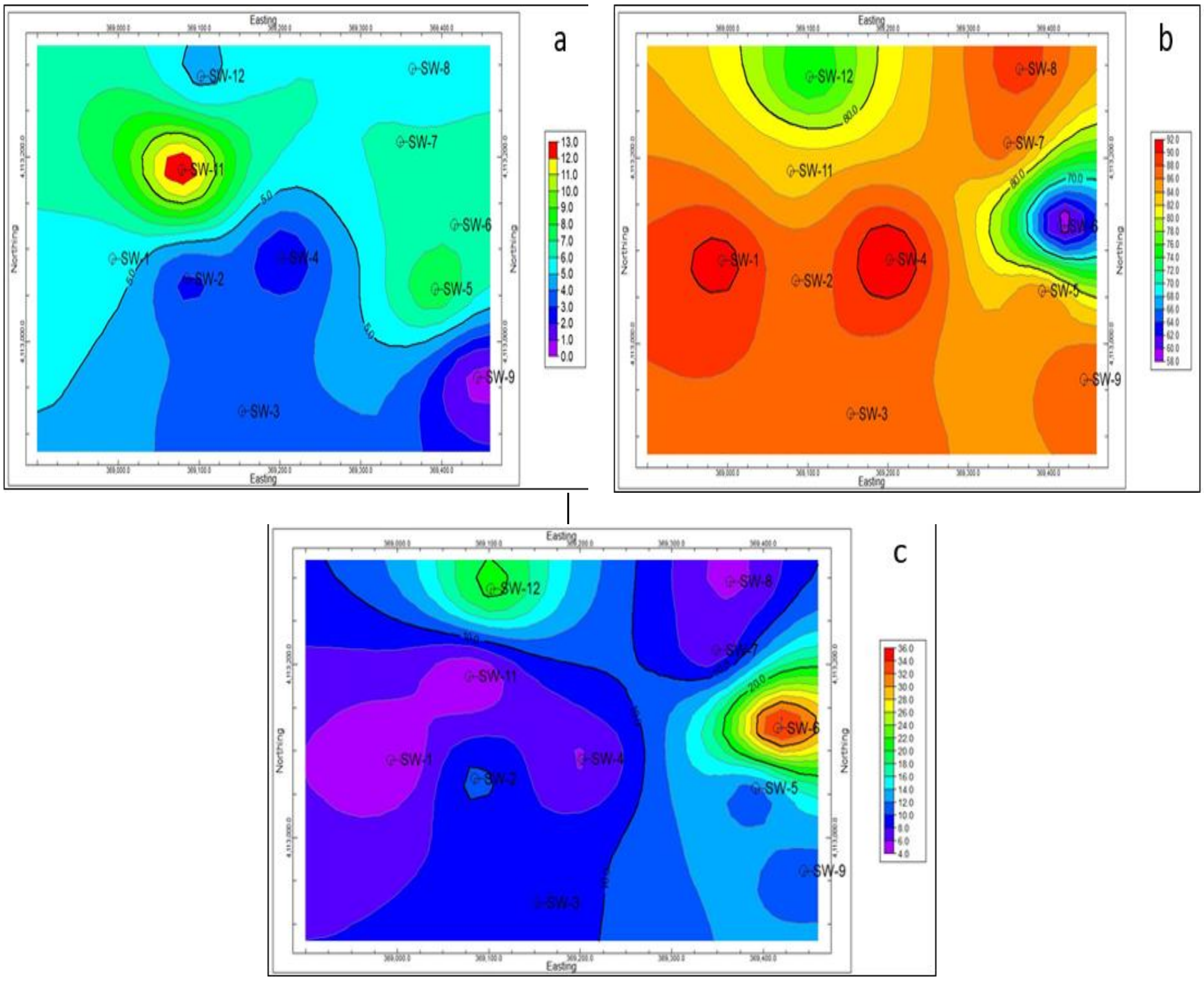

Fig. 4: Characteristics of sediment particles in subsurface sediments.

Before examining the results of geochemistry on the commonly used charts and their interpretation, it is necessary to describe the statistical processing of the decomposition of the main and secondary elements. The comparison of the oxide elements of the above samples with upper continental crust (UCC) is evident in Table-1 and in Fig. 5,6.

As shown in Table-1, the mean value of SiO_2 in the wetland sediments is 63.1, which is close to but slightly less than the average of this oxide in the upper continental crust (SiO_2 = 66.6). Its value varies from 50 (in surface sample 11 and core 10) to 69 (in core 8 and 11), which shows the good maturity of sediments, especially in cores 8 and 11. The average of CaO is about 0.8, which is less than the average of upper continental crust and only in core 12 and surface sediments 11 in the northwest of the lagoon the amount of the oxide is higher than the average of the continental crust, which has reduced the SiO_2 content in these areas (Das *et al.,* 2006, Bhatia and Crook, 1986).

The amount of Na_2O and K_2O in all samples is less than the upper continental crust that indicates the destruction of plagioclases as a result of chemical weathering in the source or during the transport process. In addition, the amount of K_2O far more than Na_2O that can be due to the presence of k Feldspar or Mica (Oni *et al.,* 2014).

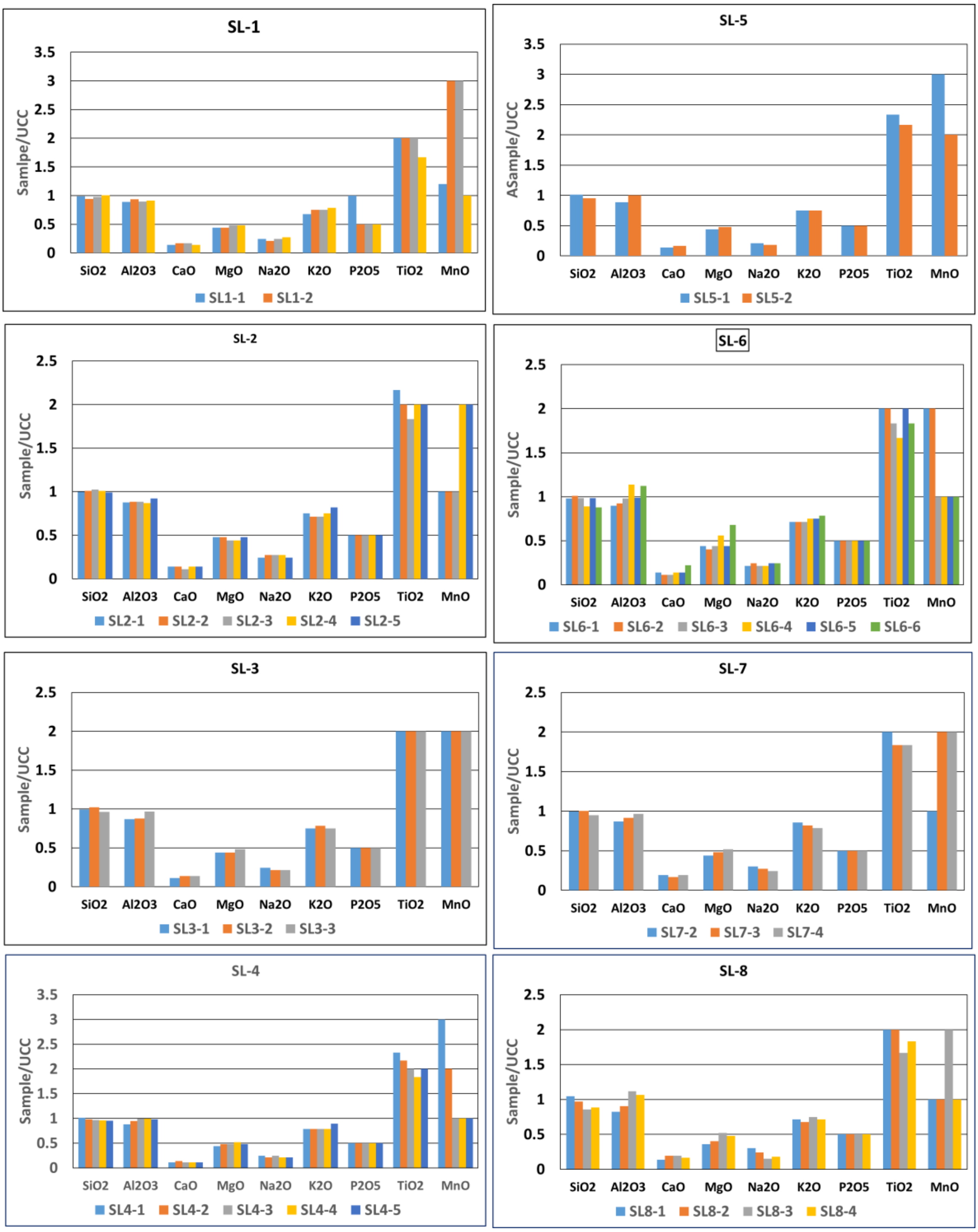

Fig. 5: Normalization of the major oxides in comparison to the composition of the upper continental crust (UCC) (Taylor and McLennan, 1985; Das *et al.*, 2006)

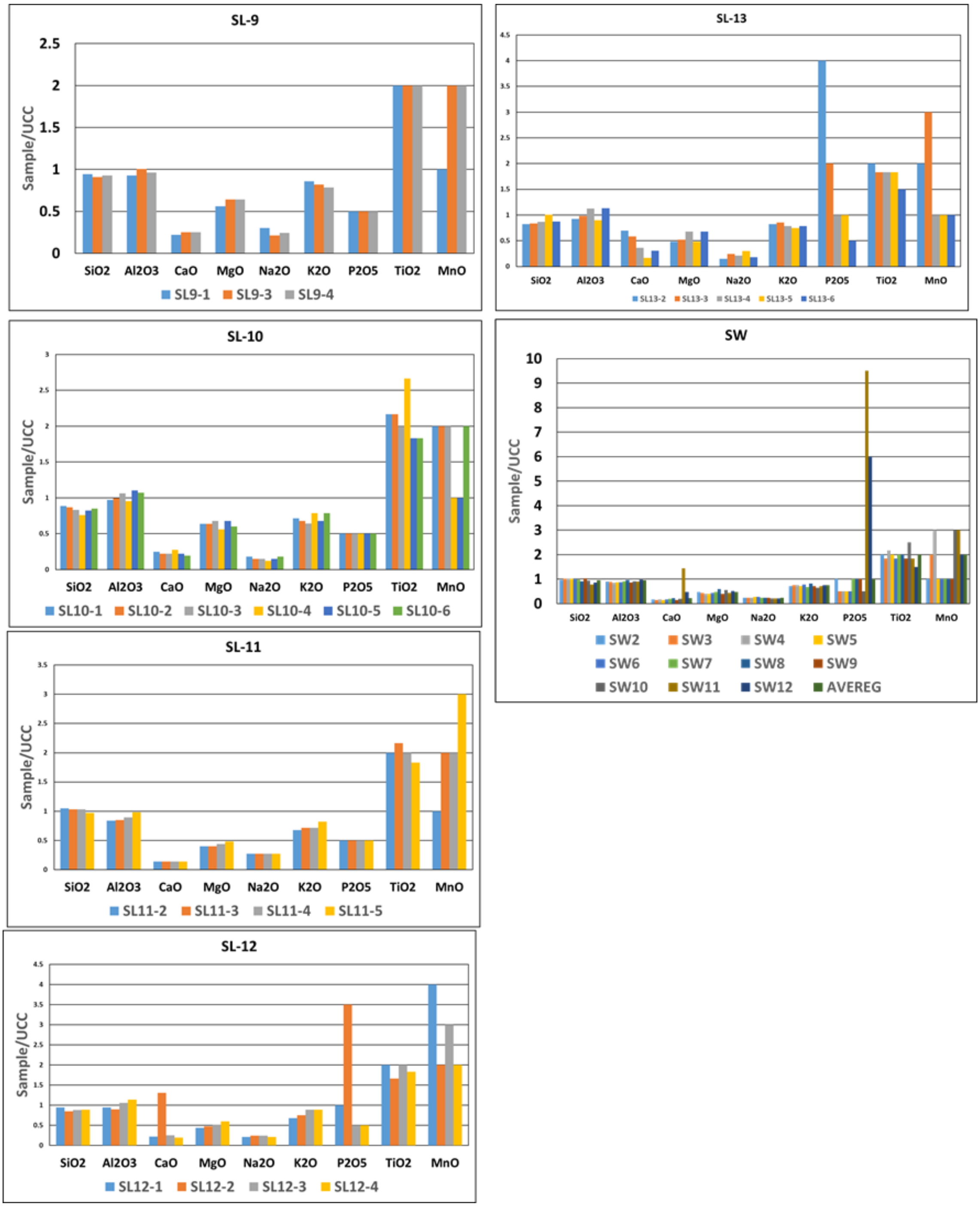

Fig. 6: Normalization of the major oxides in comparison to the composition of the upper continental crust (UCC) (Taylor and McLennan, 1985; Das *et al.,* 2006)

The comparison of MgO in sediment samples at different depths and upper continental crust shows that the average of this oxide is 1.2, which is lower than the upper continental crust (2.2). However, the comparison of the Fe_2O_3 content in the samples with the upper continental crust shows that the amount of this element is higher in the samples and indicates the weathering of iron minerals during the erosion and transport (Lee, 2005). The average of TiO_2 (1.23) in all samples is higher than the upper continental crust, which indicates the acidic and felsic source rock (Oni *et al.,* 2014).

The average of Al_2O_3 is about 14.6, which is approximately equal to the average of the upper continental crust and varies from 12 (in core 11) to 17.5 (in cores 10 and 6).

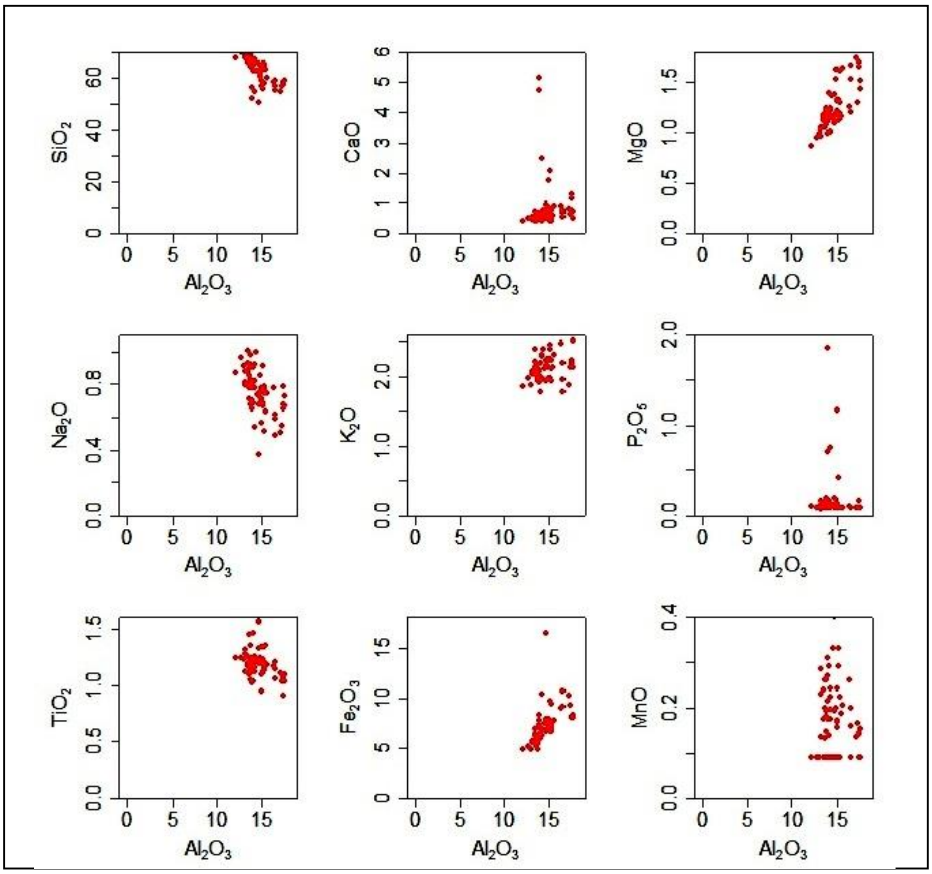

Fig. **7:** Dual charts of Al2O3 variations against other oxides (Babeesh, 2017; Madukwe and Basi, 2015).

According to (Lee,2005), the decrease of CaO, Na_2O, and SiO_2 and the increase of Al_2O_3 and Fe_2O_3 indicate an increase in weathering during the transport process and the production of simple clays and aluminum oxide and iron oxide due to the decomposition of complex clays and non-clay minerals. According to the studies, Babish (Babish *et al.,* 2017) used geochemical map diagrams including the relation between Al_2O_3 and other existing oxides for sediments (Madukwe and Obasi,2015; Babeesh *et al.,* 2017), too (Fig. 6) and the diagrams were plotted for the fine-grained sediments (Fig. 6). As can be seen, Al_2O_3 has a positive correlation with Fe_2O_3, MgO and K_2O, and a negative relationship with SiO_2 and TiO_2, but it has no special relationship with P_2O_5, MnO, and CaO. The positive correlation between Al_2O_3, Fe_2O_3 and K_2O can be due to the presence of these elements in clay minerals and mica, which have been generated due to weathering during transportation and erosion (McLennan *et al.,* 2001; Jin *et al.,* 2006). Furthermore, K_2O can represent a rich of aluminum, especially illite (Lee, 1999; Das *et al.,* 2006) (Fig. 7). These changes are most commonly observed in cores 10 and 12, and surface sample 11, indicating severe weathering during the transport in these two parts of the wetland.

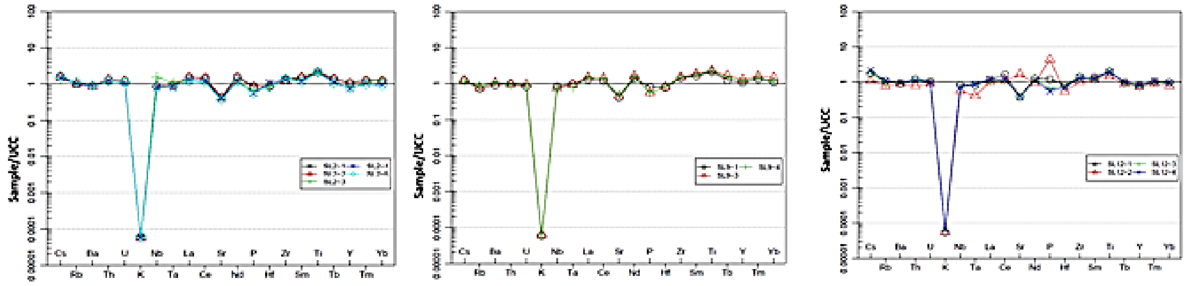

Fig. 8: Normalization of the secondary elements in comparison to the composition of the upper continental crust (UCC) (Taylor and McLennan, 1985)

The comparison of the secondary elements of the sediments of the studied zone with the combination of the upper continental crust (Fig. 7) shows the means of Zr, Yb, Y, Ti, Sm, Ce, Hf, Tb, Nd, U, La, Cs are higher, the means of Sr, Nb, and K are lower, but the rates of HF, TA, U, Th, Ba, and Rb are approximately equal. The only difference in the core 12 at the depth of 20 to 30 cm where the value of Ta decreases and the values of Sr and Hf value increase (Table-1 and Fig. 8).

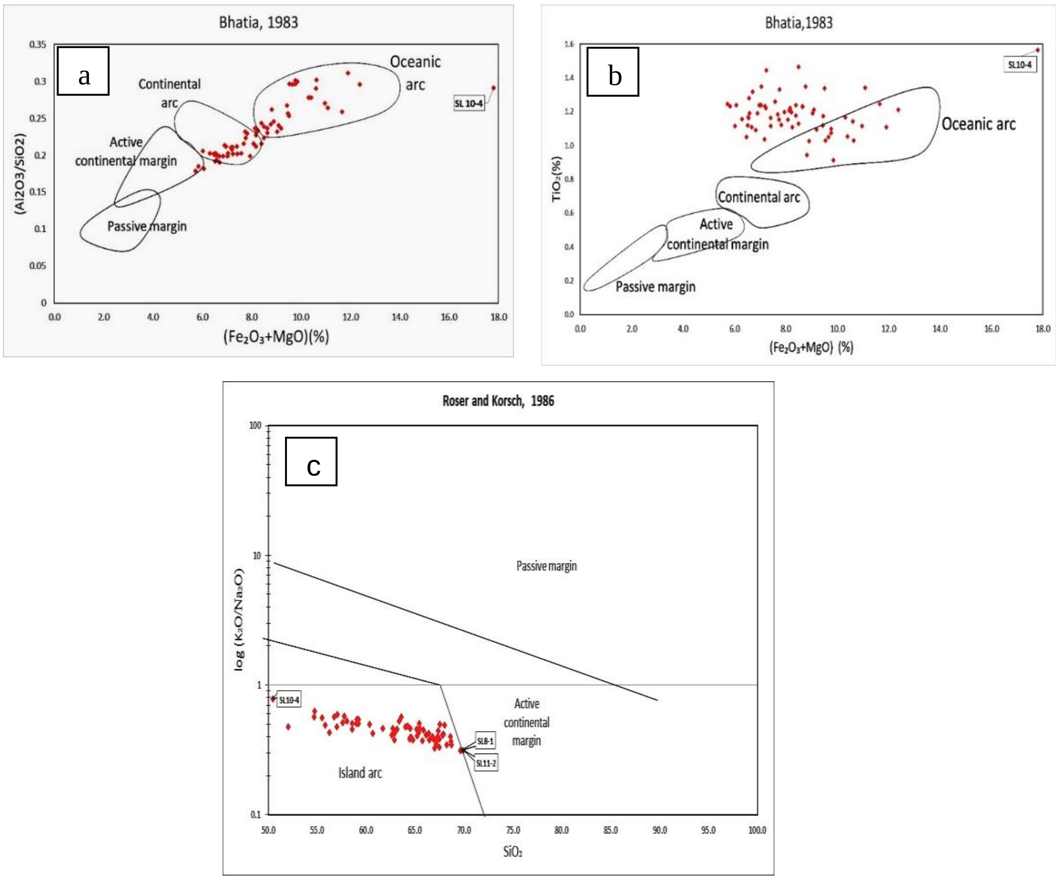

Fig. 9: a: Plot of samples on Bathia's (Bhatia, 1983) two-dimensional diagram to determine the tectonic origin of sediments using Al_2O_3 / SiO_2 versus Fe_2O_3 + MgO. b: Plots of samples on the Bathia's (Bhatia,1983) two-dimensional diagram to determine the tectonic origin of sediments using the percentage of TiO_2 versus Fe_2O_3 + MgO. c: Plots of samples on Bathia

and Cyrus's (Bhatia and Crook, 1986; Babeesh *et al.,* 2017 Das *et al.,* 2008) two-dimensional diagram to determining the tectonic origin of sediments using log (K_2O / Na_2O) versus SiO_2.

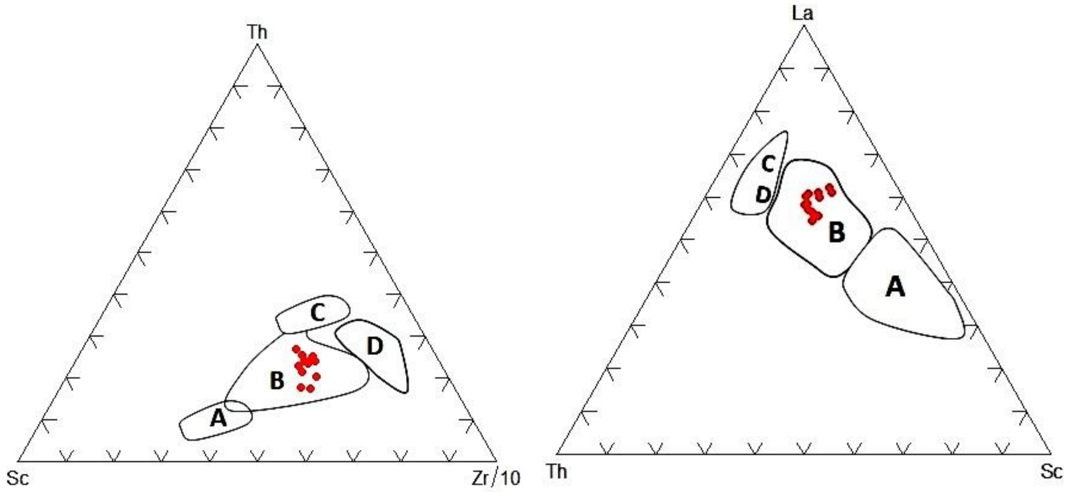

Fig. 10: Plots of samples on the three-dimensional graph of secondary elements of Bathia and Cyrus (Bhatia and Crook, 1986; Das *et al.,* 2006) to determine the tectonic origin of sediments. A: Oceanic island Arc, B: continental island Arc, C: active continental margin, D: passive continental margin

Tectonic status:

Tectonics is the basis for the complete development of the foreland basins in the active margins (Saengsrichan *et al.,* 2010). Formation and evolution of foreland basins are initially accompanied by the processes of compression, accumulation, and shortening near the orogeny. The tectonic position is influenced by factors such as sedimentation, diagenesis, and sediment composition. Therefore, in studying the tectonic origin of sediments, various methods of petrology and Geochemistry are used because the plate tectonic stages have a large share in the remaining geochemical signs (Oni *et al.,* 2014). Thus, this study tried to identify the tectonic position and history of the source rock by relying on the previous tectonic and geochemical findings.

Fine-grained sediments have a very low permeability and can retain the composition of the source rock (Bhatia, 1983; Chamley, 1990). That is why they are of great importance in the studies of origin (Hessler and Lowe, 2006). Therefore, geochemical studies of sediments and siliceous rocks can be used for naming and determining the tectonic position (Nesbitt and Young, 1982; Bhatia, 1986; Roser and Korsch, 1988 Herron, 1988; Kroonenberg, 1994; Cox *et al.,* 1995; Fedo *et al.,* 1995).

Based on changes in the values of the main elements, it is possible to separate the clastic deposits resulting from the erosion of the oceanic archipelago, the continental arc islands, the active continental margin and the passive margin from each other (Roser and Korsch, 1988). The major oxides of K_2O and Na_2O, Al_2O_3, SiO_2 are used to determine the long-standing tectonic position of sediments. Moreover, the secondary elements such as Cr, Y, Ti, Zn, Sc, Th, and La are less affected due to non-mobility in weathering, diagenesis, and moderate transformation. Therefore, they remain in the sediments and are good indicators for understanding their long-standing tectonic position (Bhatia and Crook, 1986).

Considering the adaptation of wetland samples on the dual diagrams of the oxides of main elements provided by Bathia, Rosser and Cyrus (Fig 9, 10), it seems that the above sediments are more oriented to the continental- oceanic and archipelagic islands and, of course, some of the samples are passive margins (Babeesh *et al.,* 2011; Roser and Korsch,1988; Bhatia and Crook,1986).The geochemical findings of the igneous rocks of the area by previous scholars such as Abbasian (Asiabanhan and Foden, 2012) also confirm the formation of igneous rocks that are probably the origin of the above sediments in the continental or oceanic arcs. However, since broader tectonic studies have not been carried out, it can only be claimed that these rocks result from the subduction process, but it is not truly known whether they are of the continental-oceanic or oceanic-oceanic type.

Furthermore, plotting the samples on the three-dimensional diagram of the secondary elements confirms the tectonic origin of the continental arcane border for the above samples (Bhatia and Crook, 1986; Das *et al.,* 2006) (Fig. 10).

CONCLUSION

In this study, the geochemical effects of the existing quaternary sediments of the Saghalak-Sar wetland were examined to provide information on the origin of the sediment, the degree of weathering, and the tectonic position of the source rocks of the sediments. In this regard, the geochemical analysis (ICP, XRF) was performed after the graduation of the selected samples and geochemical and granular data were analyzed using standard diagrams and software and the following results were obtained:

1- Lateral changes in the amount of mud and sand in the wetland show that in the northwest and northeast of the wetland the amount of sand is more and vice versa in the southwest and southeast of the wetland the amount of mud is more.
2- Statistical data showed that sediments of Saghalak-Sar wetland have poor to moderate sorted, also most of the samples have a mesokurtic to platykurtic curve indicating that the sand has poor sorting, therefore they are carrier, and deposited by muddy flow (in rainy seasons) or river.
3- The geochemical results and the correlation of a number of oxides of the main elements on the existing diagrams show the tectonic setting of these sediments with continental and oceanic arc islands and active continental margins. This multiplicity is characteristic of post-collision and near-source basins, which is the result of active tectonics of the region and the formation of the small sedimentary basins within the foreland, but inevitable the source rocks of the above sediments are formed by a subduction boundary.

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Table-1: Frequency of main elemental oxides in sediments

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2	MnO	L.O.I.*
SL1-1	65.7	13.7	6.1	0.5	1.1	0.8	1.9	1.2	0.12	8.13
SL1-2	62.7	14.4	7.5	0.6	1.1	0.7	2.1	1.2	0.3	8.71
SL1-3	65.2	13.8	7	0.6	1.2	0.8	2.1	1.2	0.3	7.28
SL1-4	66.9	14.1	6	0.5	1.2	0.9	2.2	1	0.1	6.78
SL2-1	66.4	13.5	6.4	0.5	1.2	0.8	2.1	1.3	0.1	7.36
SL2-2	67.2	13.6	5.1	0.5	1.2	0.9	2	1.2	0.1	7.87
SL2-3	68.3	13.6	5.7	0.4	1.1	0.9	2	1.1	0.1	6.44
SL2-4	67.2	13.4	6.9	0.5	1.1	0.9	2.1	1.2	0.2	6.26
SL2-5	65.9	14.2	6.9	0.5	1.2	0.8	2.3	1.2	0.2	6.5
SL3-1	66.1	13.4	5.4	0.4	1.1	0.8	2.1	1.2	0.2	9
SL3-2	68	13.5	5.9	0.5	1.1	0.7	2.2	1.2	0.2	6.29
SL3-3	64.2	14.9	7	0.5	1.2	0.7	2.1	1.2	0.2	7.66
SL4-1	67.4	13.6	6.2	0.4	1.1	0.8	2.2	1.4	0.3	6.46
SL4-2	65.4	14.6	6.6	0.5	1.2	0.7	2.2	1.3	0.2	7.09
SL4-3	64.5	15.3	6.9	0.4	1.2	0.8	2.2	1.2	0.1	7.27
SL4-4	64	15.3	7.2	0.4	1.3	0.7	2.2	1.1	0.1	7.39
SL4-5	63.6	15.1	7.4	0.4	1.2	0.7	2.5	1.2	0.1	7.57
SL5-1	67.5	13.7	5.9	0.5	1.1	0.7	2.1	1.4	0.3	6.52
SL5-2	63.4	15.4	7.6	0.6	1.2	0.6	2.1	1.3	0.2	7.35
SL6-1	65.2	13.8	5.8	0.5	1.1	0.7	2	1.2	0.2	9
SL6-2	67.3	14.2	6.2	0.4	1	0.8	2	1.2	0.2	6.45
SL6-3	65.5	15.1	6.7	0.4	1.1	0.7	2	1.1	0.1	7.13
SL6-4	59.2	17.5	8.1	0.5	1.4	0.7	2.1	1	0.1	9.17
SL6-5	65.4	15.2	6.6	0.5	1.1	0.8	2.1	1.2	0.1	6.94
SL6-6	58.6	17.3	8	0.8	1.7	0.8	2.2	1.1	0.1	9.25
SL7-2	66.4	13.4	6.3	0.7	1.1	1	2.4	1.2	0.1	7.1
SL7-3	66.8	14.1	6.2	0.6	1.2	0.9	2.3	1.1	0.2	6.35
SL7-4	63.2	14.9	7.9	0.7	1.3	0.8	2.2	1.1	0.2	7.44
SL8-1	69.7	12.7	5.1	0.5	0.9	1	2	1.2	0.1	6.7
SL8-2	64.5	13.9	7.4	0.7	1	0.8	1.9	1.2	0.1	8.36
SL8-3	57.1	17.2	9.3	0.7	1.3	0.5	2.1	1	0.2	10.23
SL8-4	59	16.4	9.2	0.6	1.2	0.6	2	1.1	0.1	9.81
SL9-1	62.9	14.3	6.8	0.8	1.4	1	2.4	1.2	0.1	8.9
SL9-3	60.4	15.5	7.8	0.9	1.6	0.7	2.3	1.2	0.2	9.05
SL9-4	61.7	14.8	7.5	0.9	1.6	0.8	2.2	1.2	0.2	8.85
SL10-1	59.1	15	7.9	0.9	1.6	0.6	2	1.3	0.2	11.18
SL10-2	57.8	15.3	9.5	0.8	1.6	0.5	1.9	1.3	0.2	10.9
SL10-3	55.5	16.4	10.7	0.8	1.7	0.5	1.8	1.2	0.2	11.07
SL10-4	50.5	14.7	16.4	1	1.4	0.4	2.2	1.6	0.1	11.69
SL10-5	54.7	17	10.2	0.8	1.7	0.5	1.9	1.1	0.1	11.72
SL10-6	56.7	16.5	9.1	0.7	1.5	0.6	2.2	1.1	0.2	11.2
SL11-1	67.5	12	4.9	0.4	0.9	0.9	1.9	1.2	0.1	10
SL11-2	69.9	12.9	4.8	0.5	1	0.9	1.9	1.2	0.1	6.44
SL11-3	68.7	13.1	5.7	0.5	1	0.9	2	1.3	0.2	6.38
SL11-4	68.7	13.8	5.5	0.5	1.1	0.9	2	1.2	0.2	5.92
SL11-5	64.5	15.1	7.1	0.5	1.2	0.9	2.3	1.1	0.3	6.82
SL12-1	62.9	14.6	7.9	0.8	1.1	0.7	1.9	1.2	0.4	7.92
SL12-2	56.3	13.8	7.7	4.7	1.2	0.8	2.1	1	0.2	11.18
SL12-3	58.6	16.3	9.1	0.9	1.3	0.8	2.5	1.2	0.3	8.79
SL12-4	59.2	17.6	8.3	0.7	1.5	0.7	2.5	1.1	0.2	8.01
SL13-2	54.8	14.2	10.4	2.5	1.2	0.5	2.3	1.2	0.2	11.52
SL13-3	55.8	15.1	9.7	2.1	1.3	0.8	2.4	1.1	0.3	10.75
SL13-4	57.6	17.3	8.1	1.3	1.7	0.7	2.2	1.1	0.1	9.71
SL13-5	67	13.8	4.8	0.6	1.2	1	2.1	1.1	0.1	7.88
SL13-6	58	17.4	8.2	1.1	1.7	0.6	2.2	0.9	0.1	9.39
SW2	64.6	13.8	5.7	0.6	1.2	0.8	2	1.2	0.1	9.56
SW3	67.8	13.7	5.3	0.5	1.1	0.8	2.1	1.1	0.2	7.1
SW4	67.9	13.1	5.5	0.6	1	0.8	2.1	1.3	0.3	7.13
SW5	67.5	13.5	5.5	0.5	1	0.9	2	1.2	0.1	7.47
SW6	67.2	13.4	5.6	0.6	1.1	0.9	2.2	1.1	0.1	7.41
SW7	64.8	14	6.5	0.7	1.2	0.8	1.9	1.2	0.1	8.48
SW8	60.7	14.8	6.9	0.8	1.5	0.8	2.3	1.2	0.1	10.47
SW9	68.6	13.2	5.5	0.5	1	0.8	2	1.1	0.1	6.73
SW10	62.6	14	7.1	0.7	1.4	0.7	1.8	1.5	0.3	9.52
SW11	52	13.9	8.3	5.2	1.1	0.7	2	1.1	0.3	13.24
SW12	57	15	7.5	1.7	1.3	0.7	2.1	0.9	0.2	12.01
AVEREG	**63.1**	**14.6**	**7.2**	**0.8**	**1.2**	**0.8**	**2.1**	**1.2**	**0.2**	**8.4**
UCC	**66.6**	**15.4**	**2**	**3.6**	**2.5**	**3.3**	**2.8**	**0.6**	**0.1**	
LCC	**54.4**	**16.1**		**8.5**	**6.3**	**2.8**	**0.3**	**1**		